

Thinking Styles and the Big Five Personality Traits

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ABSTRACT *The purpose of the present study was to investigate the relationship between thinking styles and the big five personality traits. One-hundred-and-fifty-four (mean age 20 years) second-year university students from Hong Kong participated in the study. Participants responded to the Thinking Styles Inventory based on Sternberg's theory of mental self-governance and to the NEO Five-Factor Inventory (NEO-FFI, Costa & McCare, 1992). Although significant relationships were identified between particular thinking styles and certain personality traits, it was concluded that it is premature to claim that a personality measure, such as the NEO-FFI can be used to measure thinking styles.*

Investigations of the relationships between styles and personality traits have long occupied many scholars (e.g. Eysenck, 1978; Riding & Wigley, 1997; Shadbolt, 1978). In general, there are two different conclusions regarding the necessity for assessing the two constructs separately. For example, Busato *et al.* (1999) examined the relationships between learning styles and the Big Five personality traits among 900 university students. The authors employed Vermunt's (1992) inventory of learning styles and the personality traits as measured by Elshout & Akkerman's (1975) 'vijf persoonlijkheidsfactoren test, 5PFT', the first published questionnaire ever, specially designed to measure the personality factors known as the Big Five. They concluded that although there was some systematic overlap between the learning styles and the personality traits assessed, it certainly makes sense to measure learning styles and personality separately in educational settings. By contrast, after studying the relationships between learning styles as assessed by the Learning Styles Questionnaire (Honey & Mumford, 1982) and personality traits as measured by the Eysenck Personality Questionnaire, Jackson & Lawty-Jones (1996) concluded that learning style is a sub-set of personality and need not be measured independently, unless when learning style is of interest in its own right. In a similar vein, Furnham (1992, 1996a,b) concluded that in the interest of parsimony, personality tests could be used to examine learning styles.

Learning styles is one of the commonly used terms in the literature on styles. The other two most commonly used terms are cognitive styles and thinking styles. There are differences and similarities among these styles. On the one hand, these three terms, although historically overlapping, are somewhat different (Sternberg & Zhang, 2001). Learning styles can be used to characterise how one prefers to learn about a topic. Cognitive styles address how one tends to cognise certain information. Thinking styles concern how one prefers to think about the material as one is learning about it or after one already knows it. On the other hand, although the three terms have differences as just mentioned, they have one thing in common. That is, they are different from abilities. An ability refers to what we can do and a style refers to our preferred ways of using the abilities that we have.

One of the most recent theories on styles is Sternberg's (1988, 1997) theory of mental self-government. Sternberg contended that just like there are many ways of governing a society, there are many ways that people use their abilities. He defined our preferred ways of using our abilities as our thinking styles. In this theory, 13 thinking styles fall along five dimensions. The Functions dimension has the legislative, executive and judicial styles. The Forms dimension includes the hierarchic, oligarchic, monarchic and anarchic styles. The Levels dimension has the global and local styles. The Scopes dimension contains the internal and external styles. Finally, the Leanings dimension includes the liberal and conservative thinking styles. A brief description of each of the 13 thinking styles can be found in Appendix 1.

As a relatively new theory on styles, the theory of mental self-government has several characteristics. First, the styles it specifies fall along five dimensions, rather than upon one. Secondly, styles are perceived as falling along continua, rather than as being dichotomous. Thirdly, styles are not regarded as 'good' or 'bad' in themselves. The utility of a style for a person interacts with the task the person is performing and the situation in which the task is performed. Finally, the theory of mental self-government yields a profile of styles for each individual, rather than merely the identification of a single style.

The theory of mental self-government has been operationalised through several inventories, including the Thinking Styles Inventory (Sternberg & Wagner, 1992), the Set of Thinking Styles Tasks for Students (Grigorenko & Sternberg, 1993a), the Students' Thinking Styles Evaluated by Teachers (Grigorenko & Sternberg, 1993b), and the Thinking Styles in Teaching Inventory (Grigorenko & Sternberg, 1993c). We have tested the theory in Hong Kong, mainland China, the Philippines, as well as in the United States. Detailed data are reported in original articles. Some of our main findings are as follows:

First, students' thinking styles vary as a function of both their personal characteristics (e.g. age, gender and socio-economic status) and their situational characteristics (e.g. work, travel and leadership experiences). Secondly, teachers' thinking styles differ depending on their teaching experiences (e.g. length of teaching experience and subject matters taught) and their perceptions of their work environment (e.g. academic autonomy and quality of students taught). Thirdly, students tend to be better evaluated by their teachers when their thinking styles match those of their teachers. Fourthly, students' thinking styles contribute to their academic performance over and above what can be explained by their abilities. Finally, as predicted, thinking styles are related to such constructs as teaching approaches, learning approaches, personality types and self-esteem. Detailed findings can be obtained from Sternberg & Grigorenko (1995), Zhang (1999, 2000a,b, 2001), and Zhang & Sternberg (1998).

However, the thinking styles defined in the theory of mental self-government have not been tested against the Big Five personality traits, the most widely recognised personality dimensions in psychology. The model for the Big Five personality traits was chosen to be studied with thinking styles mainly because these personality traits have been claimed by many scholars (e.g. Goldberg, 1993; Taylor & MacDonald, 1999) as a model that accounts for most of the variability in personality.

The five factor model (FFM) is the product of several decades of factor analytic research focusing on trait personality. According to Taylor & MacDonald, the model was initially proposed by Galton (1884) and empirically followed up by Allport & Odbert (1936) and Norman (1963) among many others. The FFM can be understood as a descriptive taxonomic theory of normal personality traits, which is composed of five mainly independent dimensions that have been reliably obtained across extensive investigations. The five personality dimensions are Neuroticism (N), Extraversion (E), Openness to Experience (O), Agreeableness (A) and Conscientiousness (C). The following paragraph briefly describes the characteristics of each of the five personality dimensions as illustrated in Costa & McCrae's (1992) work.

Neuroticism is the opposite of emotional stability. People high on the N scale tend to experience such negative affects as emotional instability, embarrassment, guilt, pessimism and low self-esteem. People scoring high on the Extraversion scale tend to be sociable and assertive. Extraverts also prefer to work with people. Openness is characterised by such attributes as open-mindedness, active imagination, preference for variety and independence of judgment. Also, people who are high on the O scale tend to be less conservative and traditional. People high on the Agreeableness scale are fundamentally altruistic, sympathetic and readily helpful. Also, they value and respect other people's beliefs and conventions. Individuals who are high in the Conscientiousness scale are characterised as being purposeful, strong-willed, responsible and trustworthy.

The FFM has received the attention of many personality psychologists. The work of Costa & McCrae (1985, 1992) is one of the most noteworthy. According to the review work of Taylor & MacDonald (1999), the NEO Personality Inventory (Costa & McCrae, 1985, 1992) has not only demonstrated exceptional psychometric properties, but also been successful in accommodating constructs already assessed by existing measures of personality traits. Among these measures are the Myers-Briggs Type Indicator (Briggs & Myers, 1987) and the Sixteen Personality Factor Questionnaire (Cattell *et al.*, 1970). Moreover, the NEO-PI also has been proved to be correlated with the Eysenck Personality Inventory (Eysenck & Eysenck, 1964), which is one of the most popular tools in the research of personality. Furthermore, the NEO-PI also has been successfully utilized in the investigation of the relationships of personality to other important variables such as creativity and divergent thinking (e.g. McCrae, 1987), achievement motivation (e.g. Busato *et al.*, 1999), and career decision making (e.g. Shafer, 2000). A short version of the NEO Personality Inventory is the NEO Five-Factor Inventory (Costa & McCrae, 1992), which also has been proved to reliably assess the five personality dimensions (e.g. Courneya & Hellsten, 1998; Saucier, 1998)

However, the five factor model has not been tested against the thinking style construct. Can the NEO Five Factor Inventory be used to identify thinking styles as defined in the theory of mental self-government or thinking styles need to be measured separately using an inventory that is specially designed for assessing thinking styles? Given the findings in the existing style-personality literature, we expected that the five personality dimensions should overlap with thinking styles. However, only through

empirical data can we find out the extent to which the two overlap. Therefore, the aim of the present study was to investigate the overlap between thinking styles and personality traits through using the Thinking Styles Inventory and the NEO Five Factor Inventory.

Based on the definitions of each of the thinking styles and each of the personality dimensions, the following predictions were made. First, participants who score high on Neuroticism should also score high on the executive and conservative scales, but low on the legislative and liberal scales. Secondly, Extraversion should be significantly positively related to the external scale, but significantly negatively related to the internal scale. Thirdly, Openness should be significantly positively related to the legislative, internal, judicial and liberal thinking styles, but significantly negatively related to the executive and conservative thinking styles. Fourthly, Agreeableness should be significantly positively correlated with the external style, but significantly negatively correlated with the legislative, internal and liberal thinking styles. Finally, Conscientiousness should be related to the hierarchical thinking style.

Methods

Participants

One-hundred-and-fifty-four (66 male and 88 female) second-year university students from Hong Kong volunteered to participate in this research. Of these participants, 33 students were from an Introduction to Educational Psychology class and the remaining were from an elective course on 'Critical Thinking', which can be taken by any second-year student from the participating university. Those participants from the 'Critical Thinking' course were from such areas as Social Sciences, Law, Architecture, Arts and Engineering. The ages of the participants ranged from 19 to 23 years, with a mean of 20 and a standard deviation of 0.57. Forty-five per cent of the participants were the only child of his/her family or the first-born in their families. The remaining participants were the second-born or later-born in their families.

Measures

Participants responded to the Thinking Styles Inventory (TSI, Sternberg & Wagner, 1992) and the NEO Five-Factor Inventory (NEO-FFI, Costa & McCrae, 1992). The participants also responded to a demographic information questionnaire.

The Thinking Styles Inventory is a self-report inventory consisting of 65 statements. Each five statements fall into one of 13 scales, with each scale corresponding to a thinking style in the theory of mental self-government. The participants rated themselves on a seven-point Likert scale, with 1 indicating that the statement does not at all describe the way they normally carry out tasks and seven denoting that the statement characterises extremely well the way they carry out tasks. The present study used a Chinese version of the inventory that was translated and back-translated between Chinese and English in 1996. Since no relationship was anticipated of the oligarchic and anarchic thinking styles to any of the Big Five dimensions, these two thinking styles were omitted from the present study.

The Thinking Styles Inventory has obtained reasonably good reliability and validity data with a variety of samples such as US secondary school students and teachers,

mainland Chinese university students, and Hong Kong secondary school and university students. In general, the reliability estimates for the 13 scales range from mid – 0.50s to mid – 0.80s. Moreover, both internal and external validity data have been reported. These data can be found in the work of Zhang (2000a,b, 2001) and Zhang & Sternberg (2001). In the present study, the reliability estimates are 0.75, 0.72, 0.80, 0.65, 0.52, 0.86, 0.77, 0.78, 0.76, 0.82 and 0.51, respectively, for the legislative, executive, judicial, global, local, liberal, conservative, internal, external, hierarchical and monarchic thinking styles.

The NEO Five-Factor Inventory is also a self-report inventory. It is a short version of the NEO Personality Inventory. Consisting of 60 items, the inventory is regarded as a brief and comprehensive measure of the five domains of personality. It is composed of five 12-item scales that assess each personality domain. Each item is rated on a 5-point scale from 0 to 4, with verbal anchors of strongly disagree, disagree, neutral, agree and strongly agree. The scores on the 12 items from each scale are summed to provide a total score for each personality dimension. In Appendix 2, 10 sample items are presented. Two items are from each of the five scales, with one item scoring 0 and the other scoring 4.

The NEO-FFI has good reliability and validity data that can be found in the NEO PI- R Professional Manual (Costa & McCrae, 1992). Again, the present study used a Chinese version of the NEO-FFI that was translated and back-translated between Chinese and English immediately prior to the administration of the inventory in the present study. In the present study, the reliability estimates are 0.79, 0.67, 0.48, 0.71, and 0.84, respectively, for the neuroticism, extraversion, openness, agreeableness and conscientiousness personality dimensions.

Data Analysis

Previous research has indicated that both thinking styles (e.g. Sternberg & Grigorenko, 1995; Zhang & Sachs, 1997) and the big five personality dimensions (see Costa & McCrae, 1992) could vary depending on age, birth-order, gender and education. In the present study, preliminary statistical tests were conducted to identify any possible differences based on age, birth-order, gender and fields of study. No statistically significant difference was identified in any of the variables tested.

To examine the relationships between thinking styles and personality dimensions, four statistical procedures were conducted with the aim of triangulating the findings. First, to obtain a simple picture of how individual scales across the two inventories are related, a zero-order correlation matrix was computed. Secondly, to further explore the relationships between thinking styles and personality dimensions, *t*-tests, a more stringent statistical procedure, were conducted to examine the participants' differences in thinking styles based on their scores on the five personality dimensions. Median splits were performed to divide the participants into high and low groups on each of the five personality scales. Normality is assumed for the distribution of each of the five personality scales since the significance level of Kolmogorov–Smirnov test of the variables is greater than 0.05. Thirdly, to identify the degree to which thinking styles and personality traits overlap, a multivariate analysis on the thinking styles scores was conducted, using the scale scores on the five personality traits as covariates. Finally, to understand the nature of the overlap between thinking styles and personality traits, a canonical correlation analysis on both sets of scale scores was performed.

Results

Scale Correlations Between the TSI and the NEO-FFI

The correlation coefficients among the scales from the two inventories are presented in Table I. All hypothesised relationships are supported by the data. Moreover, the majority of the correlation coefficients are statistically significant. For example, first, Neuroticism is significantly and positively correlated with the executive and conservative thinking styles. Secondly, Extraversion has a significantly positive relationship with the external thinking style. Thirdly, Openness is significantly and positively related to the legislative, judicial and liberal thinking styles, but significantly and negatively related to the conservative thinking style. Fourthly, Agreeableness has a significantly positive relationship with the external thinking style, but has a significantly negative relationship with the liberal and internal thinking styles. Finally, Conscientiousness is significantly and positively correlated with the hierarchical thinking style.

Differences in Thinking Styles by High and Low Personality Dimension Groups

As described previously, for each of the five personality dimensions, participants were classified into high and low groups by the median split procedure. Using *t*-tests, we investigated if groups with high and low personality scores significantly differ in their thinking styles. If so, are these differences in the expected directions?

Of the five personality scales, we identified significant differences in thinking styles in four scales. The Agreeableness dimension is the exception. Furthermore, all these significant differences are in the expected directions. First, the high Neuroticism group scored significantly higher on the local and conservative thinking styles than did the low Neuroticism group. Secondly, the high Extraversion group scored significantly higher on the external thinking style than did the low Extraversion group. Thirdly, the high Openness group scored significantly higher on the legislative and judicial thinking styles than did the low Openness group. Lastly, the high Conscientiousness group scored significantly higher on the hierarchical thinking style than did the low Conscientiousness group. Detailed statistics of these mean differences and *t* values are summarized in Table II.

Multivariate Analysis on Thinking Styles with Personality Traits Being Covariates

Results from the multivariate analysis also supported the overlap between thinking styles and personality traits to a degree. Wilks' Lambda test was statistically significant for all five personality scales, indicating that significant amounts of variance in the thinking styles scales were explained by the personality scales. For example, 41% of the variance in thinking styles was explained by the neuroticism scale. Also for instance, 36% of the variance in thinking styles was explained by the conscientiousness scale. Table III shows the detailed data from this analysis.

Canonical Correlations Between TSI and NEO-FFI

The canonical correlation analysis resulted in the following: Three of the five canonical correlations are statistically significant. Therefore, the first three paired sets (one set of thinking styles and one set of personality traits) of canonical loadings are used to explain the nature of the relationships between the thinking styles and the personality

TABLE I. Pearson Correlation Matrix for the Thinking Styles Inventory and the NEO Five-Factor Inventory Scales ($n = 154$)

Scale	Leg	Exe	Jud	Global	Local	Lib	Con	Internal	External	Hier	Mona
Neuro	-0.11	0.19*	0.09	-0.14	0.24**	-0.09	0.37**	0.04	0.04	-0.10	0.00
Extra	0.20*	0.02	0.28**	0.23**	0.01	0.23**	-0.15	-0.09	0.38**	0.24**	0.16
Openness	0.41**	0.08	0.28**	0.17	0.01	0.31**	-0.22**	0.23**	0.13	0.10	0.02
Agree	-0.12	0.03	-0.15	-0.11	-0.09	-0.23**	-0.07	-0.23**	0.18*	0.10	-0.03
Conscien	0.23**	0.16*	0.19*	0.23**	0.20*	0.11	0.03	0.04	0.17*	0.51**	0.19*

Note: Leg = Legislative, Exe = Executive, Jud = Judicial, Lib = Liberal, Con = Conservative, Hier = Hierarchical, Mona = Monarchic Neuro = Neuroticism, Extra = Extraversion, Agree = Agreeableness, Conscien = Conscientiousness.

* $P < 0.05$; ** $P < 0.01$.

TABLE II. Mean scores and t values for thinking styles by personality dimensions

Scale	Leg	Jud	Global	Local	Lib	Con	Inter	Ext	Hier
Neuro									
Low				4.29		4.48			
High				4.60		4.98			
(t value)				-2.53**		-3.64***			
Extra									
Low	4.86	4.39	4.19		3.97			4.53	4.59
High	5.13	4.87	4.52		4.43			5.06	5.00
(t value)	-2.03*	-3.20**	-2.43*		-2.81**			-3.58***	-2.34*
Open									
Low	4.78	4.36							
High	5.19	4.88							
(t value)	-3.27**	-3.49**							
Consci									
Low	4.83	4.48	4.24	4.28			4.42		4.41
High	5.19	4.81	4.52	4.60			4.79		5.11
(t value)	-2.84**	-2.18*	-2.04*	-2.64**			-2.31*		-4.23***

Note: Neuro = Neuroticism, Extra = Extraversion, Open = Openness, Consci = Conscientiousness.

* $P < 0.05$; ** $P < 0.01$; *** $P < 0.001$.

TABLE III. Wilks' Lambda: multivariate analysis on thinking styles with personality traits being covariates

Scale	Value	<i>F</i>	Hypothesis df	Error df	Sig.	Eta squared
Neuroticism	0.59	5.44	11	87	0.00	0.41
Extraversion	0.71	3.26	11	87	0.00	0.29
Openness	0.65	4.33	11	87	0.00	0.35
Agreeableness	0.66	4.11	11	87	0.00	0.34
Conscientiousness	0.64	4.41	11	87	0.00	0.36

traits. Regarding the first pair, the personality set of scales was dominated by a negative loading on neuroticism and by a positive loading on the openness scale. The thinking style set of scales was dominated by positive loadings on the legislative and liberal scales, and by negative loadings on the executive and conservative scales. These first paired sets of canonical loadings indicated that emotional stability and openness in personality is related to the use of creativity-generating and non-traditional thinking styles. This correlation is 0.75 ($P=0.00$).

For the second pair, the personality set of scales was dominated by high loadings on extraversion and conscientiousness. The thinking style set of scales was dominated by loadings on the legislative, judicial, global, external and hierarchical scales. These second paired sets of canonical loadings suggested that an out-going and trusting personality is related to the preference for critical thinking and a preference for working with others. This correlation is 0.66 ($P=0.00$).

Finally, in terms of the third pair, the personality set of scales was dominated by the loading on extraversion, whereas the style set of scales was dominated by a positive loading on the external style and by a negative loading on the internal style. These third paired sets of canonical loadings suggested that an out-going personality is related to a preference for working with other people. This correlation is 0.48 ($P=0.01$).

It should be noted, however, that not all personality dimensions and thinking styles were involved in these three significant paired sets of canonical loadings. For the personality dimensions, the agreeableness scale was the exception. As for the set of thinking styles, two of the eleven thinking styles scales did not result in high canonical loadings in any of the three significant pairs of relationships, these are the local and monarchic thinking styles. Detailed results on this canonical correlation analysis are presented in Table IV.

Discussion

The present study aimed at examining the degree and nature of the overlap between thinking styles and personality traits. The hypothesised relationships were tested convergently by four different statistical procedures. As presented the above, the results from different statistical procedures supported the hypotheses to various degrees. Results from the zero-order correlation confirmed almost all hypotheses. All five personality dimensions have one significant correlation with at least one of the 11 thinking styles.

Results from *t*-tests suggested less support for the hypothesised relationships than did the zero-order correlations. Participants' thinking styles did not significantly differ as a function of their scores on the agreeableness scale, although they significantly varied

TABLE IV. Canonical loadings for personality dimensions and thinking styles

Scale	1	2	3
NEO-FFI			
Neuroticism	- 0.59	-0.13	-0.02
Extraversion	0.36	0.65	0.59
Openness	0.62	0.39	-0.10
Agreeableness	-0.20	0.26	0.21
Conscientiousness	-0.14	0.74	-0.39
TSI			
Legislative	0.49	0.54	-0.23
Executive	- 0.49	0.33	-0.04
Judicial	0.15	0.62	0.18
Global	0.38	0.47	-0.12
Local	-0.36	0.30	0.02
Liberal	0.61	0.32	0.15
Conservative	- 0.62	0.09	-0.06
Internal	0.39	0.02	- 0.41
External	-0.17	0.70	0.61
Hierarchical	-0.10	0.76	-0.38
Monarchic	-0.04	0.39	-0.03
Canonical correlation	0.75	0.66	0.48
Significant level	0.00	0.00	0.01

Note: High canonical loadings are in bold characters.

depending on the participants' scores on the other four personality scales. The lack of relationship between the agreeableness dimension and the thinking styles was later confirmed by results from the canonical correlation analysis.

Results from the multivariate analysis clearly indicated that statistically significant amounts of variance in thinking styles were explained by the personality scales. Among the five personality scales, neuroticism was the scale that explained the most variance in thinking styles (41%). Extraversion explained the least variance in thinking styles (29%). It should be noted, however, that none of the personality dimensions explained even half of the variance in thinking styles.

Results from the canonical correlation analysis revealed that certain dimensions of personality and particular thinking styles are significantly related. However, as pointed out in the result section, not all the personality dimensions contributed to the overlap with thinking styles. Likewise, not all thinking styles contributed to the overlap with personality traits. This result indicated that personality traits and thinking styles overlap in a limited way, and that both personality traits and thinking styles make unique contribution to the variance in the data.

Therefore, the present study, like many other previous studies, identified significant overlap between styles and personality. For example, Furnham *et al.* (1999) found significant relationships between the Eysenck Personality Inventory (Eysenck & Eysenck, 1964) and Honey & Mumford's (1982) Learning Styles Questionnaire. Extraverts tended to be activists and introverts tended to be reflectors. Riding *et al.* (1995) concluded that participants' personality characteristics varied significantly as a function of verbal-imagery cognitive style. Verbalisers tended to be more active than imagers. Also for instance, Drummond & Stoddard (1992) identified the overlap between a learning style instrument and the Myers-Briggs type indicator. Judging type

of people tended to perceive themselves to be concrete sequential thinkers, whereas perceiving type of people tended to be concrete random thinkers.

Apart from empirical evidence about the relationship between styles and personality, there exist a few important conceptual arguments about this relationship. For example, Hashway (1998) noted that many style theories are personality based. Messick (1996) contended that style should be the construct that can be used to build a bridge between cognition and personality in education. Sternberg (1994) argued that style is at the interface between intelligence and personality.

In fact, the overlap between styles and personality traits make substantive sense. Take the relationship between the Neuroticism scale, and the executive and conservative thinking styles, for instance. People who are high on Neuroticism tend to be emotionally unstable, easily embarrassed, pessimistic and suffer from low self-esteem. It is not difficult to imagine that people who experience such negative affects would be more comfortable with working under highly structured situations, preferring being told what to do, and with carrying out tasks by adhering to existing rules (manifestation of characteristics of people with executive and conservative thinking styles). As a matter of fact, this finding between Neuroticism, and the executive and conservative thinking styles confirmed my earlier study of the relationship between thinking styles and self-esteem (Zhang, 2001), which found that participants who scored low on self-esteem reported a tendency to use the executive and conservative thinking styles. Moreover, this finding also concurred with that found by Shadbolt more than two decades ago. Shadbolt (1978) found that students who were high on Neuroticism performed better with structured teaching methods compared with unstructured teaching methods.

Consequently, it seems to be undeniable that there is a significant overlap between the two constructs. However, can these empirical findings and theoretical arguments about the relationships between the two constructs warrant the futility of the assessment of styles? I would say that the answer is negative.

There are three reasons for this answer. First, findings about the extent to which styles and personality overlap have been inconsistent. In fact, even Furnham, one of the major advocates for parsimony of measurement, identified different degrees of overlap between the two constructs on two different occasions. Whereas he reported substantial overlap between the two constructs in his 1992 study, he only identified modest correlation between the two constructs in one of his studies four years later (Furnham, 1996b).

The present study suggested that the big five personality traits cannot capture the essential variance in the data. For example, extroversion only explained 29% of the variance in thinking styles. This indicates that the thinking styles inventory has its own unique value in educational settings. Therefore, whereas the present study suggested significant relationships between the two constructs, it does not warrant the omission of assessing thinking styles.

Secondly, although two of the statistical procedures (*t*-test and multivariate analysis) used in the present study allow one to infer causal relationships between personality traits and thinking styles, whether or not the relationships between the two constructs are causal in a practical sense requires experimental studies. Therefore, given the present situation, one should not conclude that the NEO Five-Factor Inventory can be used to assess thinking styles.

Finally, a careful inspection of the semantics of the two inventories reveals that whereas the items in the Thinking Styles Inventory are more cognition-oriented, the

items in the NEO Five-Factor Inventory are more affect-orientated. Items in the TSI elicit participants' responses to situations in which they are required to deal with different tasks. Items in the NEO-FFI elicit participants' feelings about people and situations. Therefore, again, even though the two constructs overlap, they each contribute to the understanding of human individual differences.

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REFERENCES

- Allport, G.W., & Odbert, H.S. (1936). Trait names: A psycho-lexical study. *Psychological Monographs*, 47, 211.
- Briggs, K.C., & Myers, I.B. (1987). *Myers-Briggs Type Indicator: Form G*. Palo Alto, CA: Consulting Psychologists Press.
- Busato, V.V., Prins, F.J., Elshout, J.J., & Hamaker, C. (1999). The relation between learning styles, the Big Five personality traits and achievement motivation in higher education. *Personality and Individual Differences*, 26, 129-140.
- Cattell, R.B., Eber, H.W., & Tatsuoka, M.M. (1970). *The handbook for the Sixteen Personality Factor Questionnaire*. Champaign, IL: Institute for Personality and Ability Testing.
- Costa, P.T. Jr, & McCrae, R.R. (1985). *The NEO Personality Inventor*. Odessa, FL: Psychological Assessment Resources.
- Costa, P.T., Jr, & McCrae, R.R. (1992). *The NEO-PI-R: Professional manual*. Odessa, FL: Psychological Assessment Resources.
- Courneya, K.S., & Hellsten, L-A.M. (1998). Personality correlates of exercise behavior, motives, barriers and preferences: An application of the five-factor model. *Personality and Individual Differences*, 24, 625-633.
- Drummond, R.J., & Stoddard, A.H. (1992). Learning style and personality type. *Perceptual and Motor Skills*, 75, 99-104.
- Elshout, J.J., & Akkerman, A.E. (1975). *Vijf persoonlijkheids-factoren test 5 PFT*. Nijmegen, The Netherlands: Berhout Nijmegen.
- Eysenck, H.J. (1978). The development of personality and its relation to learning. In: S. Murray-Smith (Ed.), *Melbourne studies in education* (pp. 134-181). Melbourne, Australia; Melbourne University Press.
- Eysenck, H.J., & Eysenck, S.B.G. (1964). *Manual of the Eysenck Personality Inventory*. London, UK Hodder and Stoughton.
- Furnham, A. (1992). Personality and learning style: A study of three instruments. *Personality and Individual Differences*, 13, 429-438.
- Furnham, A. (1996a). The big five vs the big four: The relationship between the Myers-Briggs type indicator (MBTI) and NEO-PI five factor model of personality. *Personality and Individual Differences*, 21, 303-307.
- Furnham, A. (1996b). The FIRO-B, the learning style questionnaire and the five-factor model. *Journal of Social Behavior and Personality*, 11, 285-299.
- Furnham, A., Jackson, C.J. & Miller, T. (1999). Personality, learning style and work performance. *Personality and Individual Differences*, 27, 1113-1122.
- Galton, F. (1884). Measurement of character. *Fortnightly Review*, 36, 179-185.
- Goldberg, L.R. (1993). The structure of phenotypic personality traits. *American Psychologist*, 48, 26-34.

- Grigorenko, E.L., & Sternberg, R.J. (1993a). *Set of thinking styles tasks for students*, unpublished test, Yale University.
- Grigorenko, E.L., & Sternberg, R.J. (1993b). *Students' thinking styles evaluated by teachers*, unpublished test, Yale University.
- Grigorenko, E.L., & Sternberg, R.J. (1993c). *Thinking styles in teaching inventory*, unpublished test, Yale University.
- Hashway, R.M. (1998). *Developmental cognitive styles: A primer to the literature including an introduction to the theory of developmentalism*. Bethesda, MD: Austin & Winfield.
- Honey, P., & Mumford, A. (1982). *The manuals of learning styles*. Maidenhead: Honey Press.
- Jackson, C. & Lawty-Jones, M. (1996). Explaining the overlap between personality and learning style. *Personality and Individual Differences*, 20, 293–300.
- McCrae, R.R. (1987). Creativity, divergent thinking and openness to experience. *Journal of Personality and Social Psychology*, 52, 1258–1265.
- Messick, S. (1996). Bridging cognition and personality in education: The role of style in performance and development. *European Journal of Personality*, 10, 353–376.
- Norman, W.T. (1963). Toward an adequate taxonomy of personality attributes: Replicated factor structure in peer nomination personality ratings. *Journal of Abnormal and Social Psychology*, 66, 574–583.
- Riding, R., Burton, D., Rees, G., & Sharratt, M. (1995). Cognitive style and personality in 12-year-old children. *British Journal of Educational Psychology*, 65, 113–124.
- Riding, R.J., & Wigley, S. (1997). The relationship between cognitive style and personality in further education students. *Personality and Individual Differences*, 23, 379–389.
- Saucier, G. (1998). Replicable item-cluster subcomponents in the NEO Five-Factor Inventory. *Journal of Personality Assessment*, 70, 263–276.
- Shadbolt, D.R. (1978). Interactive relationships between measured personality and teaching strategy variables. *British Journal of Educational Psychology*, 48, 227–231.
- Shafer, A.B. (2000). Mediation of the big five's effect on career decision making by life task dimensions and on money attitudes by materialism. *Personality and Individual Differences*, 28, 93–109.
- Sternberg, R.J. (1988). Mental self-government: A theory of intellectual styles and their development. *Human Development*, 31, 197–224.
- Sternberg, R.J. (1994). Thinking styles: Theory and assessment at the interface between intelligence and personality. In: R.J. Sternberg & P. Ruzgis (Eds), *Intelligence and personality* (pp. 169–187). New York: Cambridge University Press.
- Sternberg, R.J. (1997). *Thinking styles*. New York: Cambridge University Press.
- Sternberg, R.J., & Grigorenko, E.L. (1995). Styles of thinking in the school. *European Journal for High Ability*, 6, 201–219.
- Sternberg, R.J., & Wagner, R.K. (1992). *Thinking Styles Inventory*, unpublished test, Yale University.
- Sternberg, R.J., & Zhang, L.F. (2001). Preface, in: R.J. Sternberg & L.F. Zhang (Eds.), *Perspectives on thinking, learning, and cognitive styles*. Mahwah, NJ: Lawrence Erlbaum.
- Taylor, A., & MacDonald, D.A. (1999). Religion and the five factor model of personality: An exploratory investigation using a Canadian university sample. *Personality and Individual Differences*, 27, 1243–1259.
- Vermunt, J.D.H.M. (1992). *Leerstijlen en sturen van leerprocessen in het hoger onderwijs. (Learning styles and guidance of learning processes in higher education)*. Amsterdam/Lisse, The Netherlands: Swets and Zeitlinger.
- Zhang, L.F. (1999). Further cross-cultural validation of the theory of mental self-government, *Journal of Psychology*, 133, pp. 165–181.
- Zhang, L.F. (2000a). Relationship between Thinking Styles Inventory and Study Process Questionnaire. *Personality and Individual Differences*, 29, 841–856.
- Zhang, L.F. (2000b). Are thinking styles and personality types related? *Educational Psychology*, 20, 271–283.
- Zhang, L.F. (2001). Thinking styles, self-esteem, and extracurricular experiences. *International Journal of Psychology*, 36, 100–107.
- Zhang, L.F. & Sachs, J. (1997). Assessing thinking styles in the theory of mental self-government: A Hong Kong validity study. *Psychological Reports*, 81, 915–928.
- Zhang, L.F. & Sternberg, R.J. (1998). Thinking styles, abilities, and academic achievement among Hong Kong university students. *Educational Research Journal*, 13, 41–62.
- Zhang, L.F. & Sternberg, R.J. (2001). Thinking styles across cultures: Their relationship with student learning. In: R.J. Sternberg & L.F. Zhang (Eds), *Perspectives on thinking, learning, and cognitive styles*. Hillsdale, NJ: Lawrence Erlbaum.

Appendix 1: Description of thinking styles in the theory of mental self-government

Style	Sample item	Key characteristic
Legislative	I like tasks that allow me to do things my own way.	Being creative
Executive	I like situations in which it is clear what role I must play or in what way I should participate.	Being conforming
Judicial	I like to evaluate and compare different points of view on issues that interest me	Being analytical
Monarchic	I like to complete what I am doing before starting something else.	Dealing with one task at a time
Hierarchical	When undertaking some task, I like first to come up with a list of things that the task will require me to do and to assign an order of priority to the items on the list.	Dealing with multiple prioritised tasks
Oligarchic	I usually know what things need to be done, but I sometimes have trouble deciding in what order to do them.	Dealing with multiple non-prioritised tasks
Anarchic	When working on a written project, I usually let my mind wander and my pen follow-up on whatever thoughts cross my mind.	Dealing with tasks at random
Global	Usually when I make a decision, I don't pay much attention to details.	Focusing on abstract ideas
Local	I like problems that require engagement with details.	Focusing on concrete ideas
Internal	I like to be alone when working on a problem.	Enjoying working independently
External	I like to work with others, rather than by myself.	Enjoying working in groups
Liberal	I like to do things in new ways, even if I am not sure they are the best ways.	Using new ways to deal with tasks
Conservative	In my work, I like to keep close to what has been done before.	Using traditional ways to deal with tasks

Appendix 2: Sample items from the NEO Five-Factor Inventory

Scale	Sample item	Score*
Neuroticism	I am not a worrier.	0
	I often feel inferior to others.	4
Extraversion	I do not consider myself especially 'light-hearted'.	0
	I like to have a lot of people around me.	4
Openness	I don't like to waste my time daydreaming.	0
	I am intrigued by the patterns I find in art and nature.	4
Agreeableness	I often get into arguments with my family and co-workers.	0
	I try to be courteous to everyone I meet.	4
Conscientiousness	I waste a lot of time before settling down to work.	0
	I keep my belongings clean and neat.	4

* Scores are based on the response 'strongly agree'.

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